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(54) Bone pinning system.

(57) An apparatus for securing fractured bones (40,42) in place without the use of wires. An absorbable bone pin (50) is inserted in place by a cannulated applicator (10) which is used to help drill a hole (44) for the bone pin (50) and accurately measure its depth. The applicator (10) has a scaled recess (20) in the handle which is used to measure the progress (depth) of the wire-type drill (30) as it forms the hole. The drill (30) has a marking (36) or similar means on it for registration with the applicator scale (22). The bone pin (50) is selected or cut to an appropriate length based on the depth of the hole (44) and inserted in place by a push rod (52) through the applicator guide tube. The applicator can have one or two guide tubes, and the tubes can be parallel or at angles to one another, depending on the usage desired. With a two-tube applicator, it is possible to better maintain the bone's pieces in place under compression until a bone pin is installed.

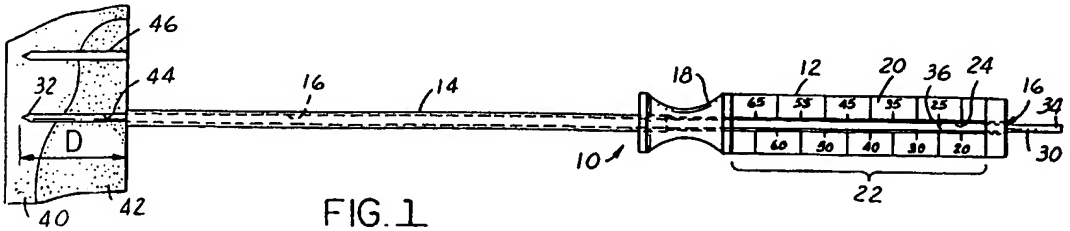

FIG. 1

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TECHNICAL FIELD

The invention relates generally to orthopedic surgery and provides a unique bone pinning system for treatment of bone fractures. In particular, the present invention relates to an improved apparatus and method for pinning and securing fractured bones together until they are healed.

BACKGROUND ART

Various methods and systems have been used to align, set and hold fractured bones together. Bone pins, screws, wires and guides of different types and styles are commonly used by surgeons to affix fractured bone pieces in place until they are healed. These bone fixation devices are typically removable or absorbable, although some are permanently installed in place.

In order to reduce trauma and recovery time, some devices and procedures have been developed which eliminate the need for making a major incision. The surgical pins or fasteners are installed into the bone with little or no prior incision. It is difficult to determine the precise depth of the pin or hole with some of these prior systems, and the end of the pin is often left exposed or protruding from the bone which can often cause discomfort or further complications.

DISCLOSURE OF INVENTION

The present invention relates to an improved surgical system and method for accurately installing and inserting bone pins to set and heal fractures. The applicator device and system allows accurate determination of the depth of the holes for the bone pins, as well as accurate placement of the pins. The pins preferably are absorbable and made of polyglycolic acid. They are selected or cut to a predetermined length prior to insertion and do not protrude from the bone or skin.

The applicator device has one or two guide tubes attached to a handle. A wire-type drill inserted through the guide tube is used to drill holes in the bone for the pins. One or more markings on the drill are matched or calibrated with a scale on a recess in the handle for accurate determination of the movement of the drill and thus the depth of each hole. Bone pins of appropriate diameters are selected and cut to the precise depth of the holes. The pins are placed in the applicator device which is used as an insertion guide. A plunger or push rod is used to forcibly push the bone pins into the holes. The pins securely hold the fractured bone pieces in place until they become fused together.

Where a single tube application device is utilized, the procedure is repeated several times until the desired number of pins are installed in place. Where a two tube application device is utilized, a guide wire, drill or bone pin positioned in one hole can be used to keep the fractured bone pieces set and held together while a second hole is formed. This prevents any disturbance of the positioning of the bones due to withdrawal of the drill or guide wire. In a two or multiple tube application, it is possible to angle or skew the orientations of the tubes in order to allow the drills and pins to "wedge" the bone pieces together and thus aid in holding them in place.

In accordance with the present invention, it is a basic object to provide an improved bone pinning system to help hold fractured bones in place until they are healed. Another object of the invention is to provide a bone pinning system which accurately and precisely determines the depth of the drilled hole and thus allows accurate selection of the appropriate pin.

It is also an object of the invention to provide a relatively simple and easy to use bone pinning system which utilizes absorbable pins and prevents them from protruding outside the bone or skin. It is a still further object of the present invention to provide a bone pinning applicator which allows the fractured bone pieces to be held securely in position during the bone pinning drilling and installation procedure.

Other advantages and objects of the invention will become more apparent from the description of the drawings and preferred embodiments as set forth in the remainder of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 illustrates the present invention being used to drill a hole for a bone pin;

FIGURE 2 is a side view of the inventive applicator device and showing a bone pin for subsequent insertion into a bone;

FIGURE 3 illustrates the insertion of a bone pin into a drilled hole in a fractured bone;

FIGURE 4 illustrates a double tube applicator device in accordance with the present invention;

FIGURE 5 illustrates an embodiment of a double tube applicator device with angled or skewed guide tubes; and

FIGURE 6 is a side view of the applicator device as shown in Figure 5.

BEST MODE FOR CARRYING OUT THE INVENTION

Figures 1-3 illustrate a single tube applicator device and its use in accordance with the present invention. The applicator device is generally designated by the numeral 10. It has a handle 12 and

a tube 14. The applicator device 10 is cannulated, that is, it has a channel or opening 16 extending throughout its length.

The handle 12 is preferably made of an auto-clavable metal (e.g. aluminum) or plastic, a disposable metal or plastic or any equivalent materials. The tube 14 is preferably made from a metal material (e.g. stainless steel) which has sufficient strength to meet the projected uses of the device 10 and also is auto-clavable.

The handle is generally circular in cross-section with a curved portion 18 at one end to aid the surgeon in manually holding and maneuvering it into position. A recess portion 20 is formed in the handle and has a scale or calibrated markings 22 on it. The markings 22 are preferably in millimeters, but they can be provided in thousandths of an inch or any convenient or appropriate scale for use by the surgeon.

The recess 20 is recessed to a depth where it intersects the opening 16 forming an open channel 24 in the handle.

The opening 16 has a cross-sectional size to allow a wire-type drill 30 (or guide wire) to be freely insertable and slidable within it. The drill 30 has a pointed tip 32 at one end. The opposite end 34 of the drill sufficiently protrudes beyond the end of the applicator device 10 and is adapted to be held in a mechanical or electrical drill (not shown).

The wire drill 30 has one or more marks 36 on it which are used to indicate its position relative to the scale 22. It is understood that any type of visible marking or fixed indication on the drill can be utilized to indicate its relative position relative to the handle. For example, the drill could have a colored ring around it at a certain point, or be provided in multiple colors and have a color separation line at a certain point. It is also understood in accordance with the present invention that the scale means could be provided on the drill and a marking of some type be positioned on the handle. It is also possible to use a guide wire in holding the bone pieces together temporarily after the hole is formed.

When the application device 10 is utilized, it is positioned against the skin or bone adjacent the fractured bone pieces 40 and 42. A wire drill 30 is then inserted in the central aperture 16 and used to drill a hole 44 in the two bone pieces. (A previously drilled hole 46 is also shown in Figure 1.) The depth D of the hole 44 is accurately determined by the movement of the mark 36 on the drill relative to the markings on the scale 22. In this manner, the surgeon can drill each bone fixation pin hole to a precise and/or desired depth.

Once the hole is formed to the prescribed depth D, the bone pin 50 is selected and cut to a length L which matches the depth D. If a series of bone pins are provided or available of different lengths, it is possible to simply select one of an appropriate length. (If pins of a certain length are provided initially, then it may be possible depending on the circumstances for the surgeon to drill the holes to a depth to match the bone pins.) If desired, the length L can be any length less than the depth D of the hole so that the pin 50 will not protrude beyond the entrance of the hole 44, and/or will promote immediate bone growth at the entrance to the hole 44.

The actuator device 10 can be provided in a kit form with a plurality of bone pins of different lengths and cross-sectional sizes. A pin is selected which matches the diameter of the drill 30 which is used to drill the hole 44. The bone pin 50 is selected of the appropriate length L or cut to a desired length for use in the surgical procedure.

As mentioned earlier, the bone pins are preferably made of an absorbable material, such as polyglycolic acid (PGA). Absorbable surgical structural elements made of PGA are disclosed in United States Patent No. 3,739,773. It is, of course, possible with the present invention to also use bone pins made of metal or another suitable material.

The bone pins preferably are on the order of 1-4.5 mm in diameter, and the actuator device (handle and tube) is preferably about 6-12 inches in length.

Once the bone pin 50 is selected of the appropriate size and length, it is placed in the opening 16 in the handle 12 (as shown in Figure 2). Due to the recess 20, the pin can be inserted in the tubular opening 16 at the position shown in Figure 2. The pin 50 is then pushed through the handle 12 and hollow tube 14 into the hole 44 by means of an elongated plunger or push rod 52. This is shown in Figure 3. The forcing of the pin 50 into the drilled hole 44 compresses the bone pieces 40 and 42 together. The pin 50 holds the fractured pieces securely together until they are fused in place and healed. In Figure 3, a bone pin 54 is shown which has been previously installed in place in second hole 46.

After the bone pins 50, 54, etc. are installed in place, the push rod 52 and applicator device 10 are removed and the wound is closed or dressed as needed. The precise number of bone pins required to securely hold the bone pieces together and heal the fracture is determined by the type and severity of the fracture and the desires of the surgeon. Typically two or more bone pins are utilized in most situations.

An alternate embodiment of the bone pin applicator device is shown in Figure 4. The device 60 has a handle portion 62 and a pair of parallel hollow tubes 64 and 66. With the exception of two

tubes and their associated openings 16', 16" and channels 24' and 24", the device 60 is essentially the same as the device 10 described with reference to Figures 1-3. The device 60 is also used in substantially the same manner as device 10 to insert absorbable bone pins in place to hold fractured bone pieces 40' and 42' together.

A pair of wire-type drills 30 and 30' are used to drill the holes in the bone pieces for the bone pins. For this purpose the device 60 is used as a drill guide in the same manner as described above with reference to Figures 1-3. Markings 36 and 36' on the drills are used to determine the depths of the drilled holes relative to the calibrated scale 22 on the handle 62 of the device 60. The scale 22 is positioned in recess 20'.

The device 60 allows the surgeon to install two bone pins in the fractured bone pieces in a quick and simple manner. The device also allows the surgeon to retain one drill or guide wire in place in the bone through one of the tubes 64 or 66 while a bone pin is installed through the other tube. This causes the bone pieces 40' and 42' to be retained securely set and affixed in place by compression until the first bone pin is installed in place.

Figures 5 and 6 disclose another two-tube embodiment 68 of the invention. In this alternate embodiment, the two tubes 70 and 72 are positioned at an angle or in a skewed relationship relative to one another. The tubes 70 and 72 are connected to a handle 74 which, similar to handles 12 and 62, has a recessed portion 20' and one or more calibrated scales 22. As shown in Figure 5, it is preferable to provide two separate scales on this embodiment, one for each of the angled tubes.

The actuator device 68 is used in the same manner and for the same purpose as the devices 10 and 60 described above. The skewed insertion tubes 70 and 72 allow the wire-type drills, guide wires and subsequently installed bone pins to act to "wedge" the fractured bone pieces 40' and 42' together and help hold them securely in place until they are healed.

Although particular embodiments of the present invention have been illustrated in the accompanying drawings and described in the foregoing detailed description, it is to be understood that the present invention is not to be limited to just the embodiments disclosed, but that they are capable of numerous rearrangements, modifications and substitutions without departing from the scope of the claims hereafter.

Claims

1. An applicator device for guiding an elongated drill to form a hole of known depth in bone and for delivering a bone pin into the hole, the device comprising:

   an elongated member having a proximal opening at a proximal end and a distal opening at a distal end and defining a first passageway extending between said proximal opening and said distal opening for slidably receiving the drill therethrough;

   view means, disposed proximate to said proximal end, for providing visual communication between the exterior of said elongated member and a portion of said first passageway;

   graduated markings, associated with said view means, for enabling alignment with the elongated drill to measure of the depth of the hole formed in the bone; and

   said elongated member defining an insertion port distal to said proximal end and communicating with said first passageway to enable insertion of the bone pin into said first passageway for placement into the hole after the hole has been formed in the bone.

2. The device of Claim 1 in which said view means and said insertion port are mutually established by a recess formed in said elongated member distal to said proximal end.

3. The device of Claim 1 further including a handle attached to said elongated member for gripping by an operator of said elongated member.

4. The device of Claim 3 in which said handle is disposed near to said proximal end.

5. The device of Claim 1 in which said elongated member includes:

   an elongated hollow handle member defining said proximal opening and having a second passageway along its length communicating with said proximal opening; and

   an elongated hollow tubular member attached to the distal end of said handle member, said tubular member defining said distal opening and having a third passageway along its length communicating with said distal opening and in axial alignment with said second passageway in said handle, said second and third passageways together establishing said first passageway.

6. The device in Claim 5 in which said handle member has a lateral recessed portion thereon intersecting said first passageway to establish said view means and said insertion port.

7. The device in Claim 6 in which said recessed

portion is at least one-half as long as said handle member.

8. The device of Claim 6 in which said recessed portion has an elongated flat portion on which said graduated markings are positioned.

9. The applicator device as claimed in Claim 1 together with an elongated drill, the drill including calibration markings which may be aligned with said graduated markings of said elongated member.

10. The applicator device and drill of Claim 9 together with a plunger dimensioned to fit within said first passageway for driving the bone pin into the hole formed in the bone.

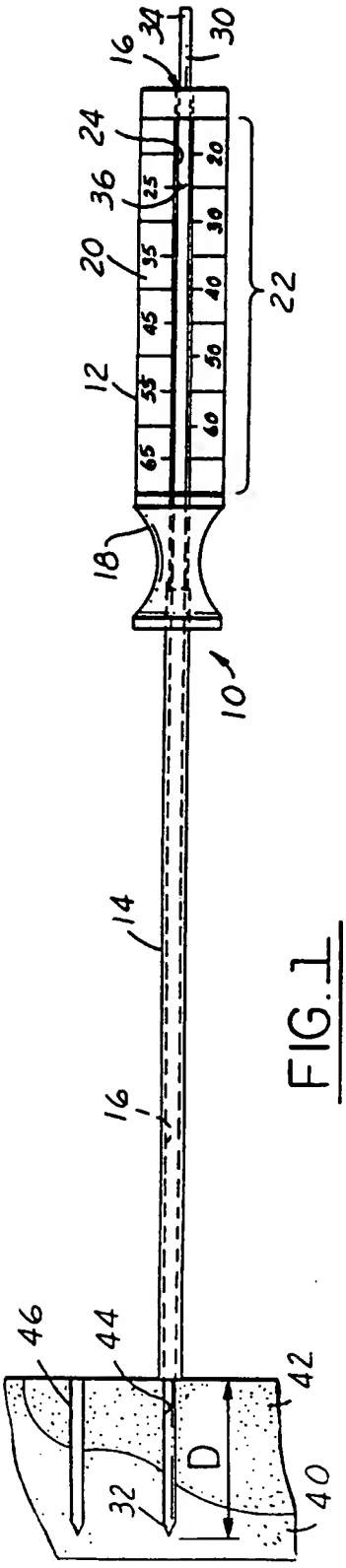

FIG. 1

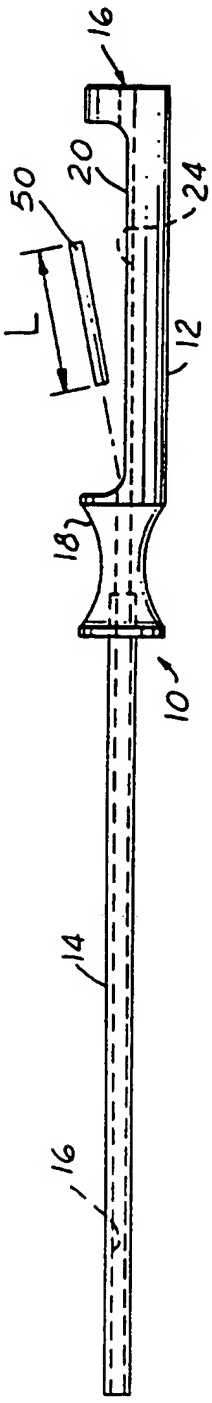

FIG. 2

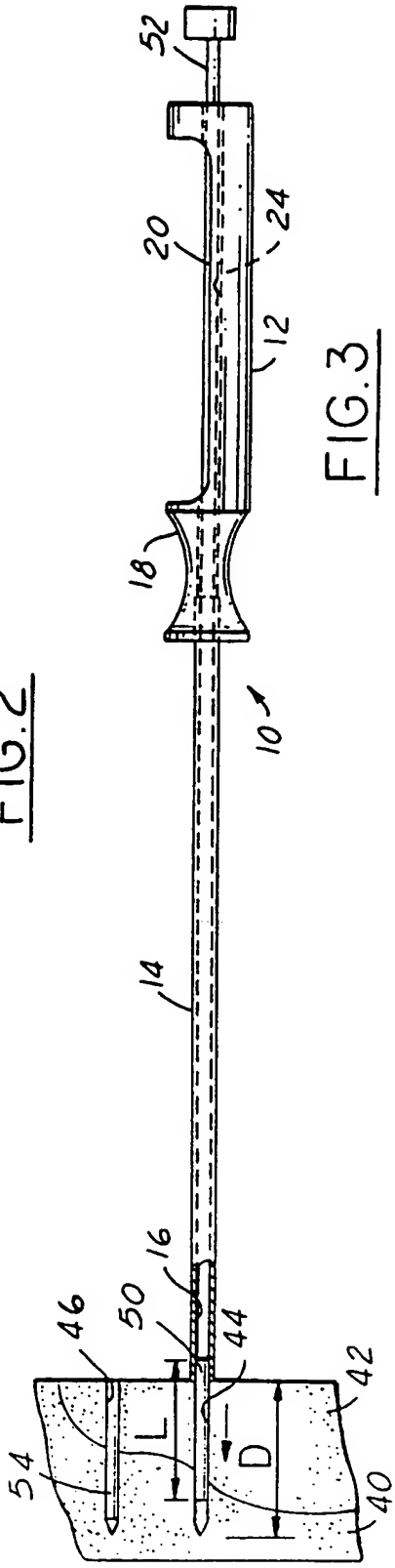

FIG. 3

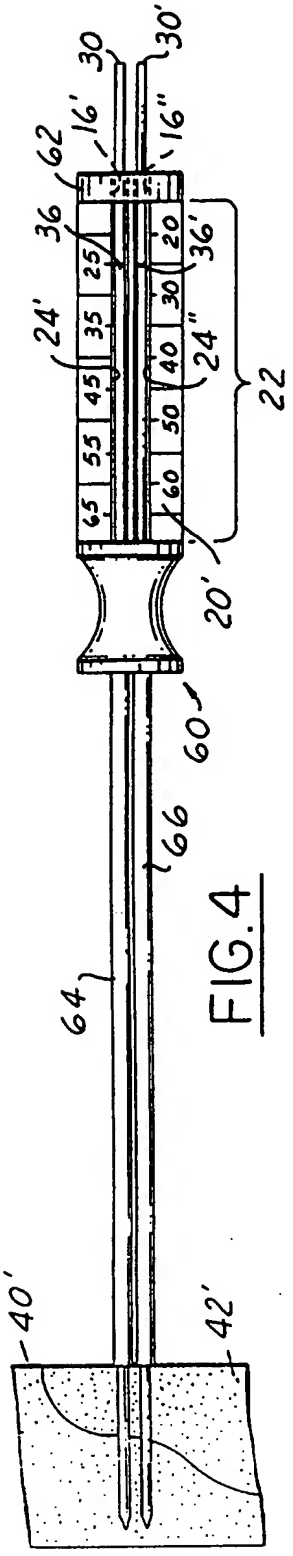

FIG.4

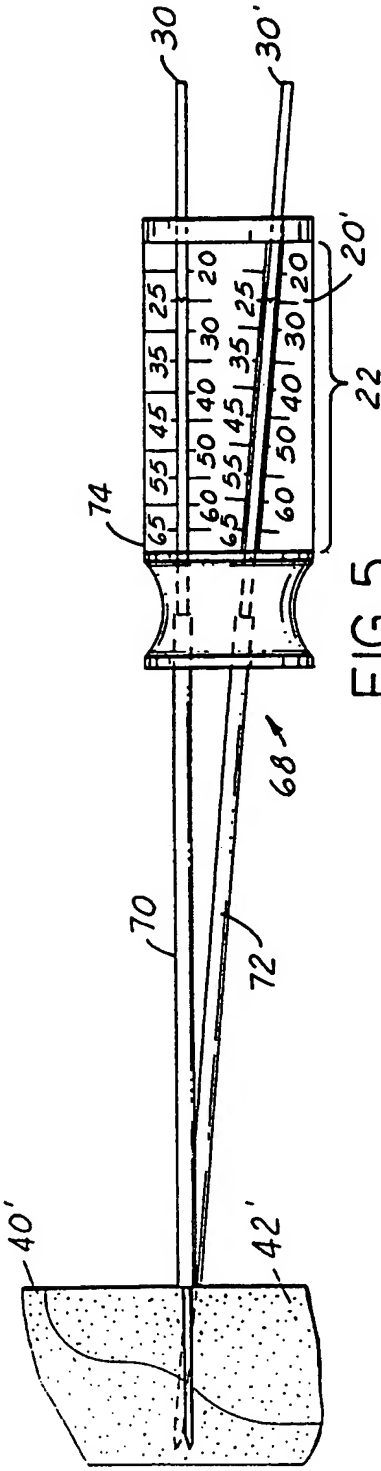

FIG.5

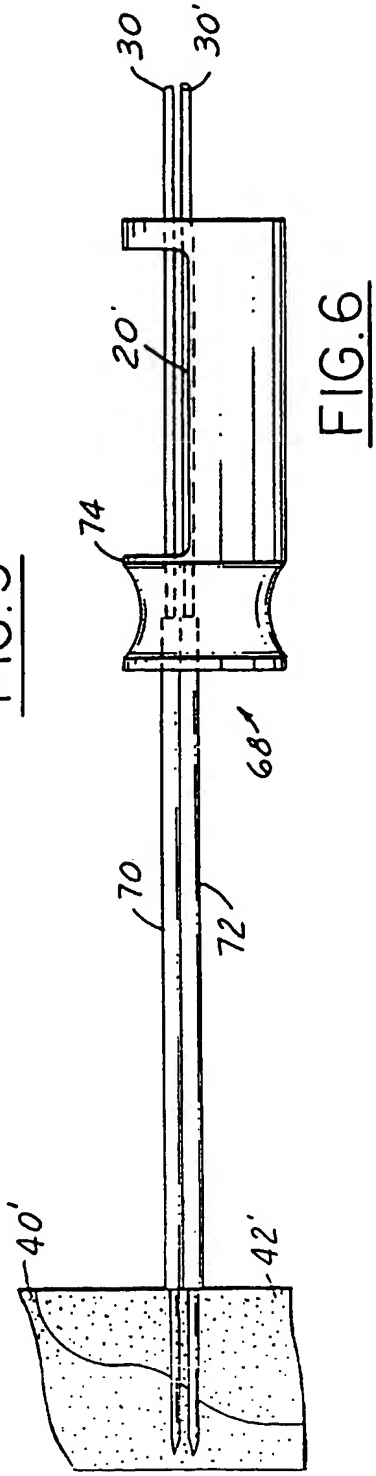

FIG.6

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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 0021

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	EP-A-0 338 779 (3M) * abstract; figure 3 *	1	A 61 B 17/58 A 61 B 17/16
A	DE-U-8 800 197 (LIST) * page 6, line 22 - page 7, line 13; figures 1-3 *	1	
A	DE-B-1 029 528 (POHL) * column 2, line 30 - column 3, line 6; figures 1-4 *	1	
A	EP-A-0 059 044 (HOWMEDICA) * abstract; figures 5,6,7,10 *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A 61 B

The present search report has been drawn up for all claims

Place of search	Date of completion of search	Examiner
The Hague	30 September 91	MOERS R.J.

CATEGORY OF CITED DOCUMENTS

X: particularly relevant if taken alone
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